ANALOG DEVICES

Evaluation Board User Guide
UG-296

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Evaluating the AD5415 Serial Input, Dual-Channel Current Output DAC

FEATURES

Full-featured evaluation board for the AD5415
Graphic user interface software for board control and data analysis
Connector to EVAL-SDP-CB1Z system demonstration platform board
Various power supply options

APPLICATIONS

Portable battery-powered applications
Waveform generators
Analog processing
Instrumentation applications
Programmable amplifiers and attenuators
Digitally controlled calibration
Programmable filters and oscillators
Composite video
Ultrasound
Gain, offset, and voltage trimming

GENERAL DESCRIPTION

The AD5415 is a CMOS, 12-bit, dual-channel, current output digital-to-analog converter. This device operates from a 2.5 V to 5.5 V power supply, making it suited to battery-powered and other applications.

As a result of being manufactured on a CMOS submicron process, this part offers excellent four-quadrant multiplication characteristics, with large signal multiplying bandwidths of 10 MHz.

The applied external reference input voltage ($V_{REF}x$) determines the full-scale output current. An integrated feedback resistor ($R_{FB}x$) provides temperature tracking and full-scale voltage output when combined with an external current-to-voltage precision amplifier. In addition, this device contains the four-quadrant resistors necessary for bipolar operation and other configuration modes.

This DAC uses a double-buffered, 3-wire serial interface that is compatible with SPI, QSPI™, MICROWIRE®, and most DSP interface standards. In addition, a serial data out pin (SDO) allows daisy-chaining when multiple packages are used. Data readback allows the user to read the contents of the DAC register via the SDO pin. On power-up, the internal shift register and latches are filled with 0s, and the DAC outputs are at zero scale. The AD5415 DAC is available in a 24-lead TSSOP package.

The evaluation board, EVAL-AD5415SDZ, is available for evaluating the performance of the AD5415 DAC.

EVALUATION BOARD FUNCTIONAL BLOCK DIAGRAM

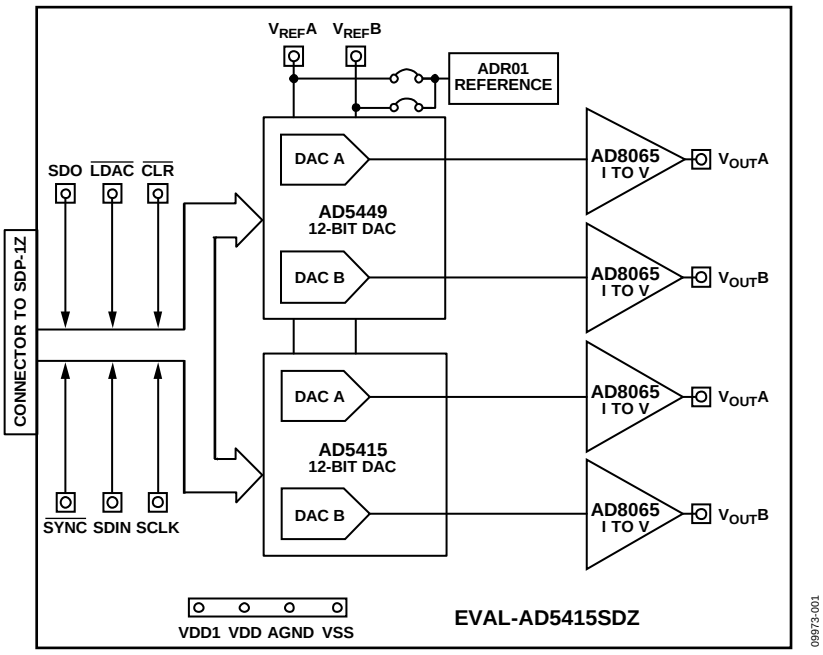

Figure 1.

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REVISION HISTORY

3/12—Rev. A to Rev. B

Changed EVAL-AD5415/AD5449SDZ to EVAL-AD5415SDZ Throughout 1
Change to Figure 1 1
Changed ADSP-BF5xx to ADSP-BF527 Throughout 3
Change to Figure 2 3
Changes to Figure 3 and Installing the Software Section 4
Changes to Using the Evaluation Board Software Section 5
Changes to Evaluation Board Schematics and Artwork Section 8

6/11—Rev. 0 to Rev. A

Document Title, Format, and Content Changed from EVAL-AD5415E, Revision 0, to UG-296, Rev. A ..... Universal

3/10—Revision 0: Initial Version

EVALUATION BOARD

The EVAL-AD5415SDZ board consists of an AD5449 DAC, an AD5415 DAC, and AD8065 current-to-voltage amplifiers. Included on the evaluation board is a 10 V reference, the ADR01. An external reference can also be applied via an SMB input. The evaluation kit consists of a CD-ROM with self-installing PC software to control the DAC. The software allows the user to write a code to the device.

The EVAL-AD5415SDZ board is used in conjunction with the EVAL-SDP-CB1Z system demonstration platform (SDP) board available from Analog Devices, Inc., which is purchased separately from the evaluation board. The USB-to-SPI communication to the AD5415 is completed using this Blackfin®-based demonstration board. The software offers a waveform generator.

SYSTEM DEMONSTRATION PLATFORM

The SDP is a hardware and software evaluation tool for use in conjunction with product evaluation boards. The SDP board is based on the Blackfin ADSP-BF527 processor with USB connectivity to the PC through a USB 2.0 high speed port. For more information about this device, see the system demonstration platform web page at www.analog.com/EVAL-SDP-CB1Z.

EVAL-AD5415SDZ TO SPORT INTERFACE

The Analog Devices SDP has one SPORT serial port. The SPORT interface is used to control the AD5415, allowing clock frequencies of up to 30 MHz.

OPERATING THE EVALUATION BOARD

The board requires ±12 V and 5 V supplies. The +12 V V_{DD} and −12 V V_{SS} are used to power the output amplifier; the 5 V supply is used to power the DAC (V_{DD}) and transceivers (V_{CC}).

Both supplies are decoupled to their respective ground plane with 10 µF tantalum and 0.1 µF ceramic capacitors.

SERIAL INTERFACE

The AD5415 has an interface that is compatible with SPI, QSPI, MICROWIRE, and most DSP interface standards. Data is written to the device in 16-bit words. Each 16-bit word consists of four control bits and 12 data bits for the AD5415. Control bits allow control of various functions on the DAC.

MICROPROCESSOR INTERFACING

Microprocessor interfacing to the AD5415 DAC is through a serial bus that uses a standard protocol compatible with micro-controllers and DSP processors.

The SDP is a hardware and software platform that provides a means to communicate from the PC to Analog Devices products and systems that require digital control and/or readback. The SDP has a Blackfin processor (ADSP-BF527) at its core.

The ADSP-BF527 processor incorporates channel synchronous serial ports (SPORT) and general-purpose input/output (GPIO) pins. A serial interface between the Blackfin processor and the AD5415 DAC is shown in Figure 2.

For more details about the system demonstration platform, see the EVAL-SDP-CB1Z at www.analog.com/EVAL-SDP-CB1Z.

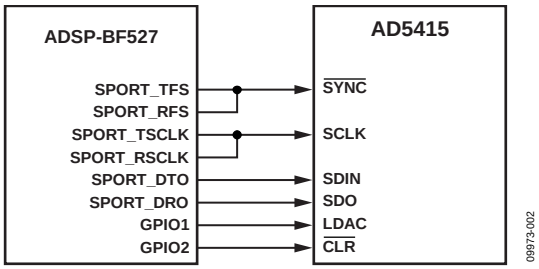

Figure 2. ADSP-BF527-to-AD5415 Interface

EVALUATION BOARD SOFTWARE

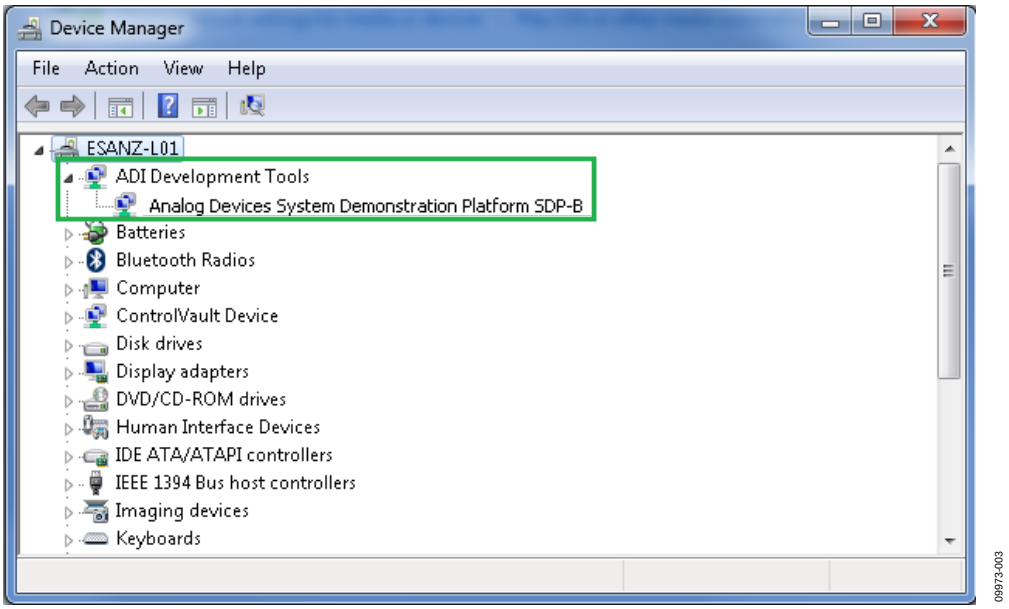

Figure 3. Device Manager Showing the SDP Board Connected

INSTALLING THE SOFTWARE

The EVAL-AD5415SDZ kit includes the software and drivers on a CD. To install the software, follow these steps:

1. Install the software before connecting the SDP board to the USB port of the PC.
2. Start the Windows® operating system and insert the EVAL-AD5415SDZ kit CD.
3. Download the EVAL-AD5415SDZ LabVIEW™ software. The correct driver for the SDP board, SDPDriversNET, should download automatically after LabVIEW is downloaded, supporting both 32-bit and 64-bit systems. However, if the drivers do not download automatically, the driver executable file can also be found in the **All Programs/Analog Devices** folder from the **Start** menu. Follow the on-screen prompts to install it.
4. After installation of the software and drivers is complete, plug the EVAL-AD5415SDZ into the SDP board and the SDP board into the PC using the USB cable included in the kit. Confirm that the SDP board has been recognized and is displayed in the **Device Manager** dialog box by clicking **Start/Control Panel/System (Hardware)/Device Manager** (see Figure 3).
5. When the software detects the evaluation board, proceed through any dialog boxes that appear to finalize the installation (**Found New Hardware Wizard/Install the Software Automatically** and so on).

RUNNING THE SOFTWARE

To run the evaluation board program, do the following:

1. Click **Start/All Programs/Analog Devices/EVAL-AD5415/49SDZ**.
2. If the SDP board is not connected to the USB port when the software is launched, a connectivity error displays (see Figure 4.). Simply connect the evaluation board to the USB port of the PC, wait a few seconds, click **Rescan**, and follow the instructions.

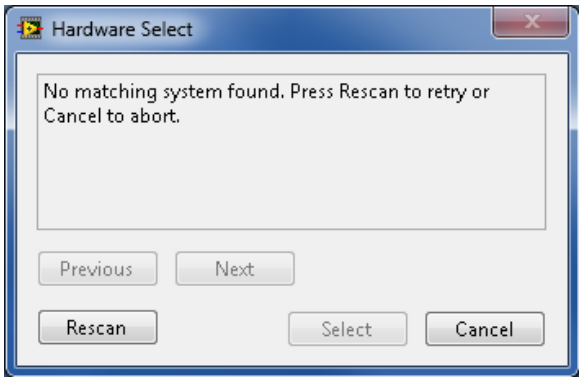

Figure 4. Connectivity Error

USING THE EVALUATION BOARD SOFTWARE

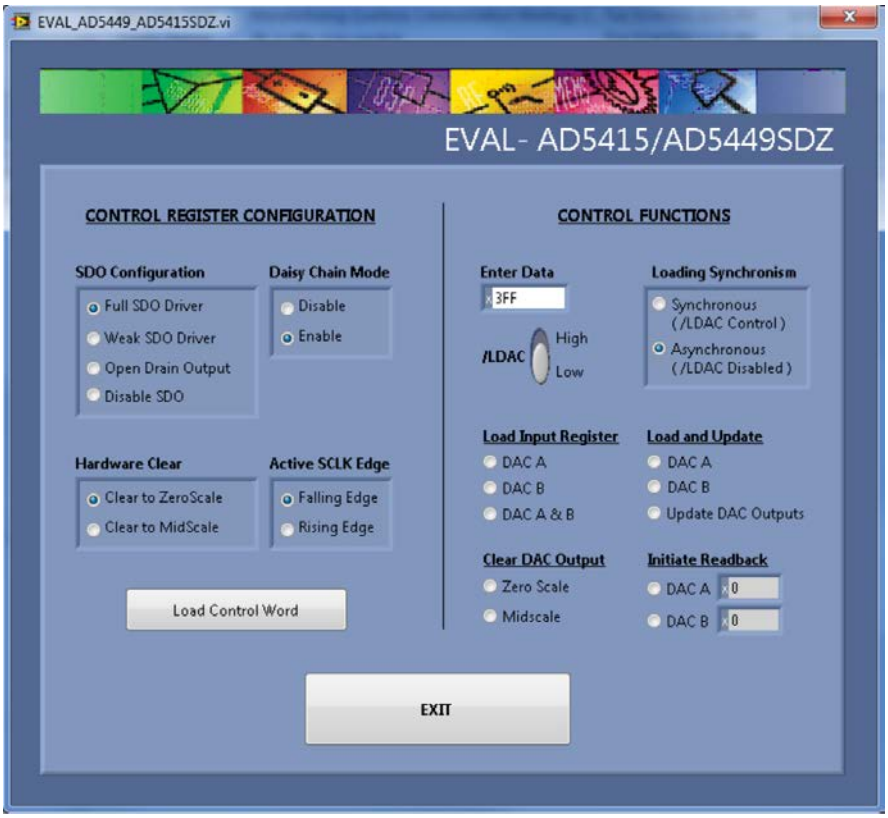

Figure 5. Evaluation Software Window

To operate the evaluation software,

1. Ensure that the PC is connected to the system demonstration platform, EVAL-SDP-CB1Z, and the EVAL-SDP-CB1Z to the evaluation board via the USB cable provided in the kit.
2. Run the program file from **Start/All Programs/Analog Devices**. The **EVAL-AD5449_AD5415SDZ** window opens, as shown in Figure 5.

EVALUATION BOARD FUNCTIONS AND REGISTERS

From the AD5415 evaluation software window, you can write a data-word to either DAC A or DAC B or both DACs. Type the 12-bit data-word in hexadecimal format in the **Enter Data** box of the **CONTROL FUNCTIONS** panel.

The AD5415 evaluation software window allows you to evaluate all the functions of the AD5415.

Example 1

Asynchronous Mode

Complete the following steps in the **CONTROL FUNCTIONS** panel of the evaluation software window:

1. Select **/LDAC High** to tie the load DAC input high for the asynchronous loading mode, specify quarter scale (0x400, 1024 decimal) in the **Enter Data** box, and select **DAC A** under **Load Input Register.** The value is kept in the register, and the DAC does not update until you click **Update DAC Outputs** under **Load and Update**. The expected output obtained is

$$V_{OUT} = -V_{REF} \times \frac{D}{4096} = -10 \times \frac{1024}{4096} = -2.5\ V$$

2. Select **Zero Scale** under **Clear DAC Output** to clear the DAC outputs to 0 V.

Synchronous Mode

1. Change **Loading Synchronism** to **Synchronous** (**/LDAC Control**), write 0xC00 (3072 decimal) in the **Enter Data** box, and select **DAC A** under **Load Input Register**. The output does not change until you select **/LDAC Low**. The expected output for this case is

$$V_{OUT} = -V_{REF} \times \frac{D}{4096} = -10 \times \frac{3072}{4096} = -7.5\ V$$

2. Click **DAC A** under **Initiate Readback** to confirm that the last value loaded in the DAC A register is the same as the one read and shown in the **DAC A** numeric indicator text box.

Example 2

Control Register Configuration

1. Working in asynchronous mode, load and update DAC B with full scale (0xFFF). The expected output is

$$V_{OUT} = \left(V_{REF} \times \frac{D}{2^{n-1}} \right) - V_{REF} = \left(10 \times \frac{4095}{2048} \right) - 10 = +10\ V$$

2. Click **Clear to MidScale** under **Hardware Clear** and **Disable** under **Daisy Chain Mode** in the **CONTROL REGISTER CONFIGURATION** panel. Next, click the **Load Control Word** button. The DAC B outputs change to midscale (0x800), and the signal in the SDO pin maintains a constant value until the daisy-chain mode is enabled again.
3. Click **EXIT** when you complete your evaluation.

Table 1 and Table 2 describe the control functions and control registers, respectively. The disable daisy-chain and clock data to shift register on rising edge mode functions are loaded with the control register. Although they can also be implemented loading the specified control bits for these functions, they are only available within the control word for the software provided.

Table 1. Control Functions

Control Function	Description
Load and Update, DAC A	Loads the DAC A register with the entered data-word and updates the DAC A output, irrespective of the state of **/LDAC**.
Initiate Readback, DAC A	Reads the contents of the DAC A register and displays the value on screen.
Load Input Register, DAC A	Loads the DAC A input register with the entered data-word. The DAC A output is updated only if **/LDAC** is low.
Load and Update, DAC B	Loads the DAC B register with the entered data-word and updates the DAC B output, irrespective of the state of **/LDAC**.
Initiate Readback, DAC B	Reads the contents of the DAC B register and displays the value on screen.
Load Input Register, DAC B	Loads the DAC B input register with the entered data-word. The DAC B output is updated only if **/LDAC** is low.
Load and Update, Update DAC Outputs (Both DACs)	Updates both DAC outputs with the entered data-word, irrespective of the state of **/LDAC**.
Load Input Register, DAC A and DAC B	Loads the input registers of both DACs with the entered data-word. Both outputs are updated only if **/LDAC** is low.
Clear DAC Output, Zero Scale (Both Outputs)	Loads both DACs and updates their outputs with zero-scale code, irrespective of the state of **/LDAC**.
Clear DAC Output, Midscale (Both Outputs)	Loads both DACs and updates their outputs with midscale code, irrespective of the state of **/LDAC**.

Table 2.

Control Register	Description
SDO Configuration	The SDO bits enable you to control the SDO output driver strength, disable the SDO output, or configure the SDO as an open-drain driver. The strength of the SDO driver affects timing. A stronger SDO output driver allows a faster clock cycle to be used.
Daisy Chain Mode	Enables or disables daisy-chain functionality.
Hardware Clear	Sets the value to which the outputs are cleared on the falling edge of the CLR signal. The value can be either zero scale or midscale.
Active SCLK Edge	Selects the edge of SCLK on which data is clocked into the input register. Data is clocked out from SDO on the opposite edge.
Load Control Word	Loads control register mode.

EVALUATION BOARD SCHEMATICS AND ARTWORK

SCHEMATICS

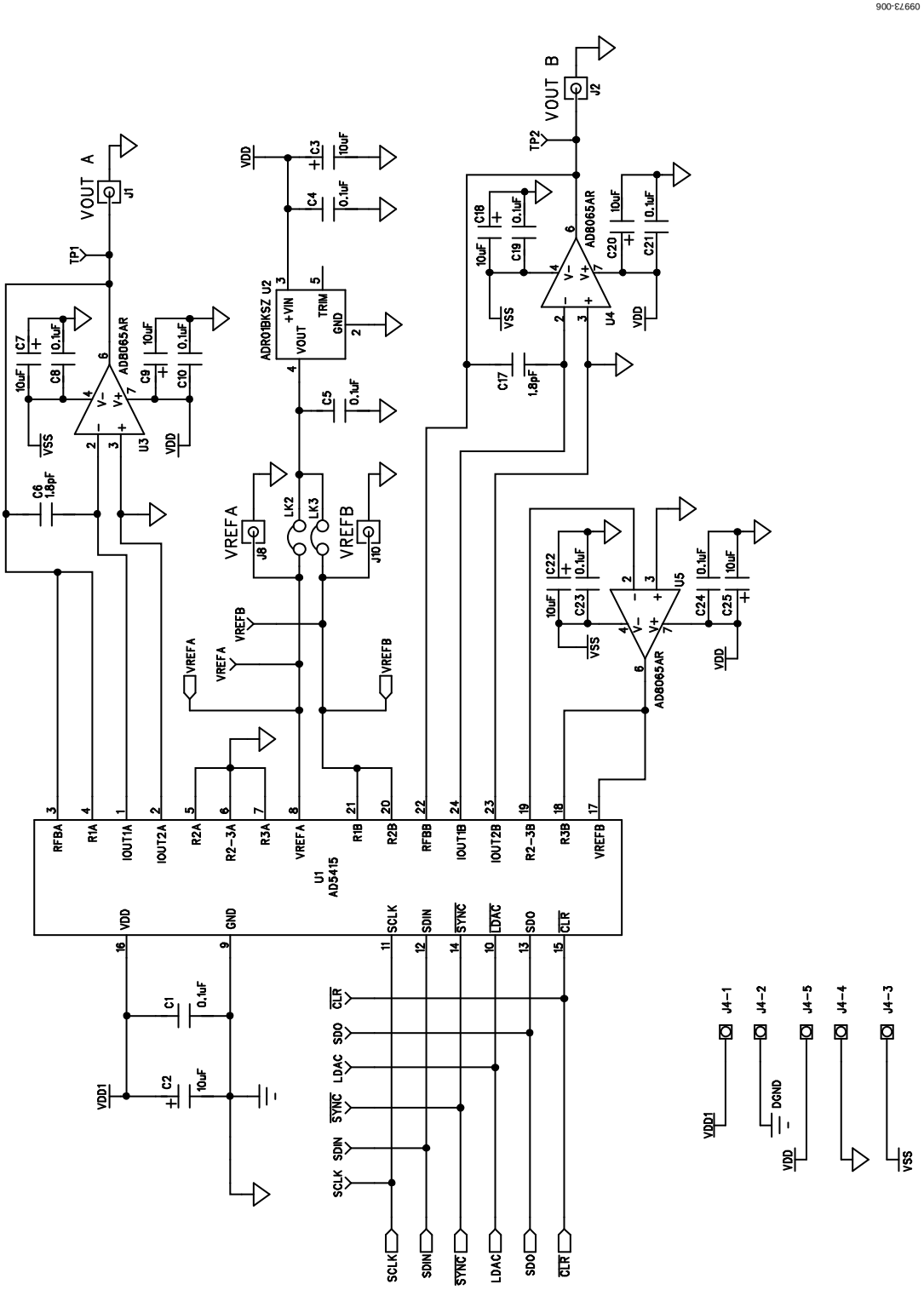

Figure 6. Evaluation Board Schematic Part A (AD5415)

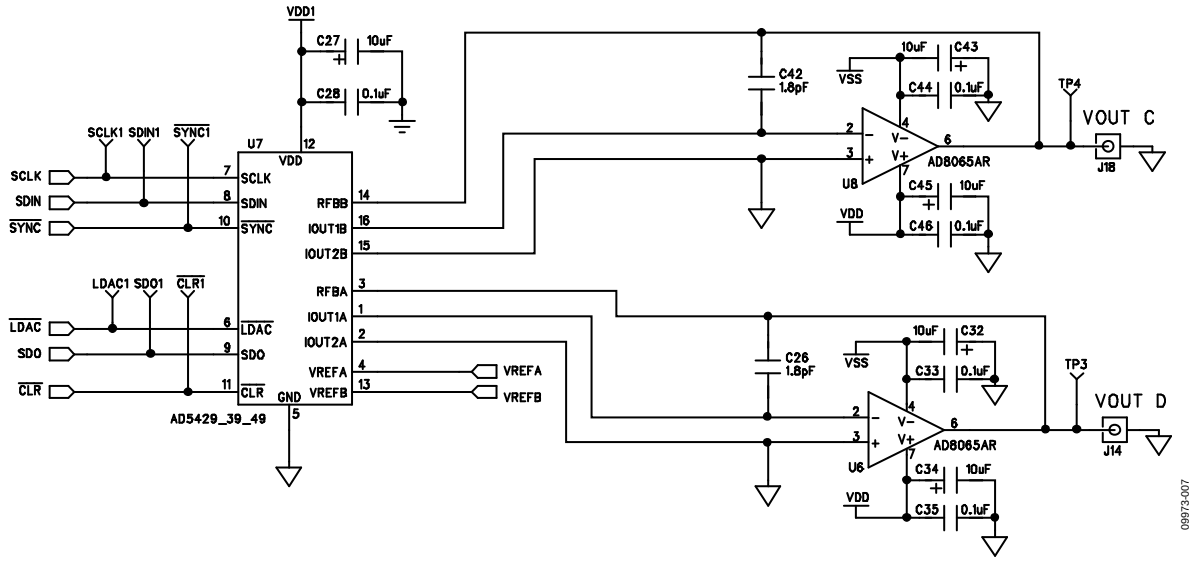

Figure 7. Evaluation Board Schematic Part B (AD5449)

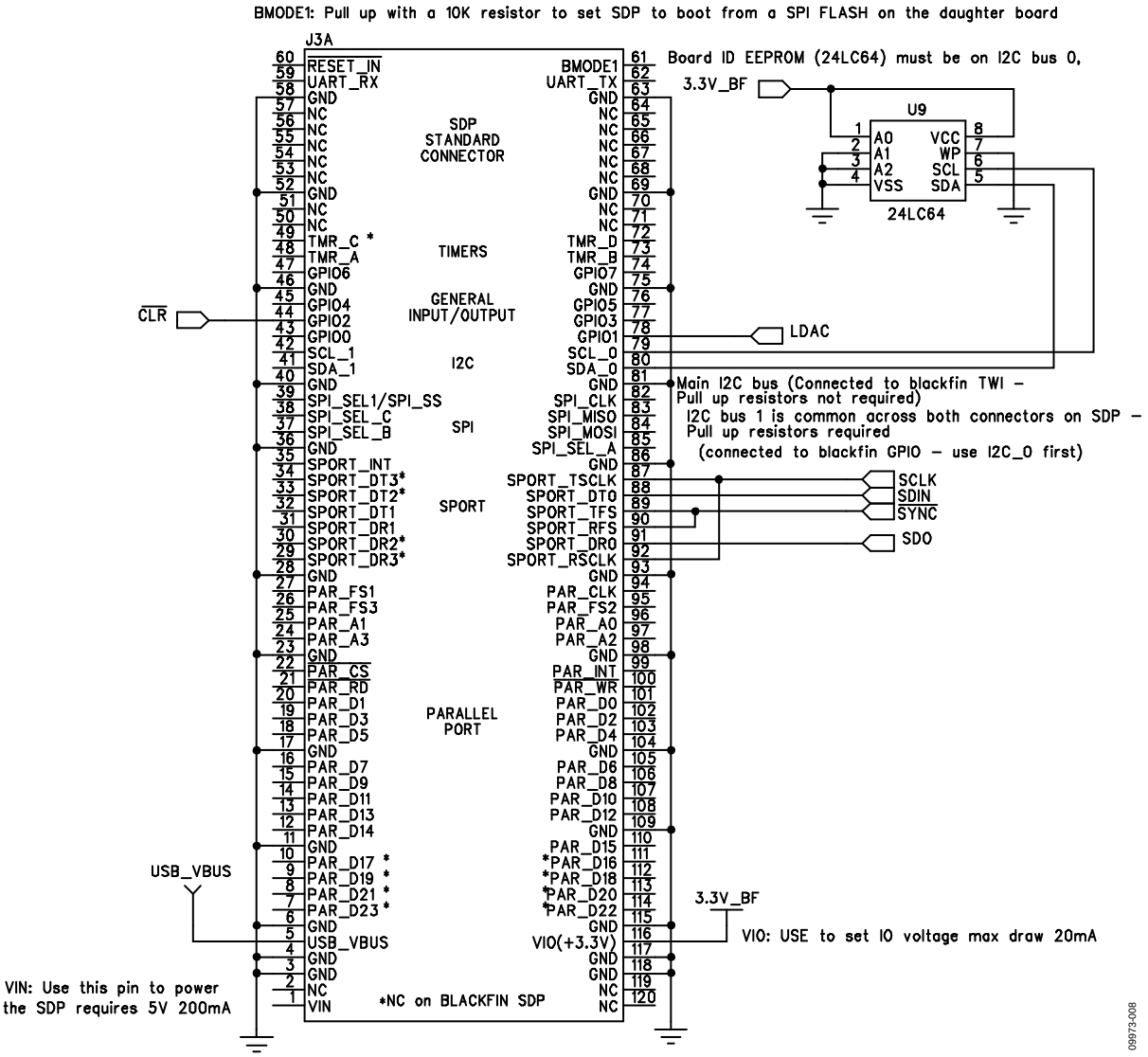

Figure 8. Evaluation Board Schematic Part C (SDP Board)

EVALUATION BOARD LAYOUT

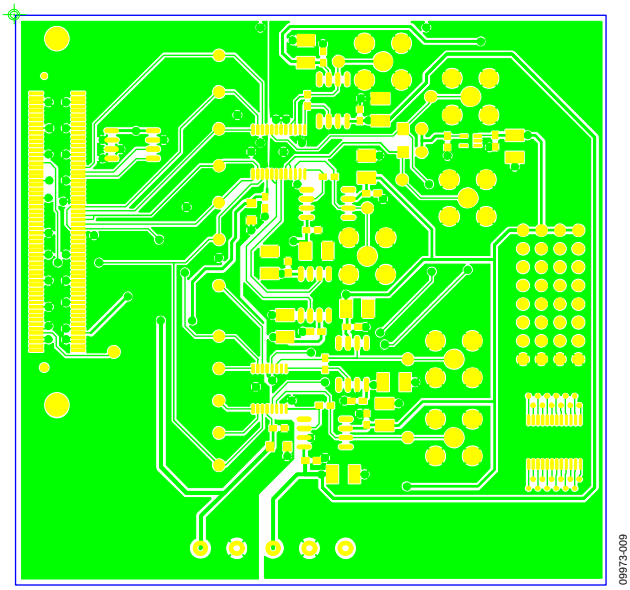

Figure 9. Component-Side Artwork

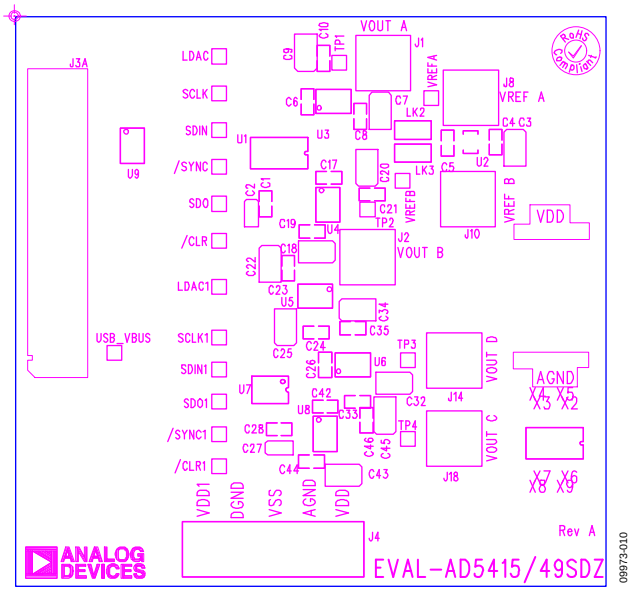

Figure 10. Silkscreen—Component-Side View (Top)

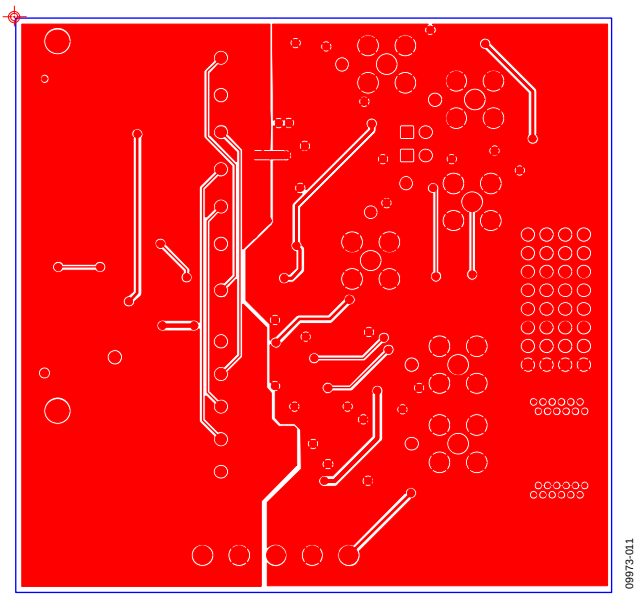

Figure 11. Solder-Side Artwork

RELATED LINKS

Resource	Description
AD5415	Product Page, AD5415 Dual 12-Bit, High Bandwidth, Multiplying DAC with Four-Quadrant Resistors and Serial Interface
AD5449	Product Page, AD5449 Dual 12-Bit, High Bandwidth Multiplying DAC with Serial Interface
ADR01	Product Page, ADR01 Ultracompact, Precision 10.0 V Voltage Reference
AD8065	Product Page, AD8065 High Performance, 145 MHz *FastFET*™ Op Amp

NOTES

ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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